Silver Lake Nutrient Loading Study, Oceana Co., MI 2012-2014

Presentation at Friends of Silver Lake Annual meeting, June 13, 2015

USGS – MI Water Science Center & GVSU-AWRI, presented by Bill DeJong

In cooperation with the Silver Lake Improvement Board

U.S. Department of the Interior
U.S. Geological Survey

Project Updates

- USGS/AWRI Silver Lake Final Report is currently out for technical review
  - The results presented here are preliminary and subject to revision, technical review, and USGS report approval
- On track for publication of report by September 30th, 2015

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Preliminary Results – Nutrients

- These study results indicate that Silver Lake is *co-limited* by both phosphorus and nitrogen. As a result, both phosphorus and nitrogen are deemed critical nutrients in the development of algal blooms and lake eutrophication in Silver Lake.

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Preliminary Results – Nutrient Budget

- Average annual phosphorus load to Silver Lake (based on 2-years of data) was 1,342 lbs and nitrogen load was almost 52,000 lbs
- Largest sources of phosphorus were groundwater (47%), Hunter Creek (29%), and lawn runoff (13%)
- Largest sources of nitrogen were Hunter Creek (56%), groundwater (25%), and atmospheric deposition (9%)

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Preliminary Results – Nutrient Budget cont.

Nutrient load, by season, to Silver Lake (based on 2-yrs of data)

- The largest loading of phosphorus AND nitrogen to Silver Lake occurred in the spring months, followed by the summer and fall. About twice as much nitrogen entered Silver Lake during the spring (19,180 lbs) compared to the fall months (8,921 lbs)

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Preliminary Results – Modeled Septic Contribution to Nutrient Budget

- Large proportion of the phosphorus load being delivered to the lake by groundwater and Hunter Creek is likely originating from septic systems. The septic model results suggest that septic systems are a major source of phosphorus loading to Silver Lake.

- "Likely" septic loading scenario estimates septic systems contribute **48%** of phosphorus to groundwater and **22%** phosphorus to Hunter Creek

- This septic model indicates that septic systems are an unlikely source of nitrogen, accounting for only **1%** of the nitrogen load to Hunter Creek and **1%** of nitrogen load to groundwater

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Preliminary Results – Nutrient Load Modeling

- The BATHTUB model was used to predict eutrophication-related water quality conditions in Silver Lake (Walker, 1985)

- The BATHTUB model was first calibrated (based on 2 yrs of data), to simulate current conditions

- Nutrient concentrations from various sources were then adjusted to simulate the effect on trophic status in Silver Lake

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Preliminary Results – Nutrient Load Modeling cont.

Silver Lake trophic status

- Trophic status: A way of classifying lakes and describing lake processes in terms of productivity of the system
- Oligotrophic – Low nutrient concentrations, low algal production, low primary productivity
- Mesotrophic – Intermediate level of productivity, commonly clear water lakes with submerged aquatic plants and medium levels of nutrients
- Eutrophic - High biological productivity due to excessive nutrients, dominated by aquatic plants or algae, can result in fish kills and algal blooms

- The current condition of Silver Lake is eutrophic (TSI > 50) based on secchi depth, chlorophyll *a*, and phosphorus concentrations (using Carlson's TSI)

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Preliminary Results – Nutrient Load Modeling cont.

1) Modeled effect of nutrient loading on trophic status-Silver Lk

- Reduction of nutrients from Hunter Creek alone may not be enough to effectively improve the trophic status and related water quality issues in Silver Lake
- If groundwater loading of P&N were decreased by 75%, and all of the other nutrient inputs stayed as they are today, the condition of Silver Lake would most likely range from highly mesotrophic to eutrophic
- A reduction of P&N from a combination of manageable sources (groundwater, Hunter Creek, & lawn runoff) by 75% would classify Silver Lake as mesotrophic which is indicative of improved water quality, water clarity, and reduced algal bloom frequency

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Preliminary Results – Nutrient Load Modeling cont.

2) Change in number of days with algal blooms

- For this study, chlorophyll *a* concentrations > 10 µg/L may indicate algal blooms are present. During the course of this study, measured chlorophyll *a* concentrations on Silver Lake ranged from 0.7 to 39 µg/L and averaged approximately 15 µg/L
- According to BATHTUB, if nutrient loading from just Hunter Ck were reduced, the lake would continue to experience algal blooms, but less frequently than current situation. The same scenario applies if nutrient loading from only groundwater were reduced
- BATHTUB model results indicate a 50% reduction of P&N from a combination of manageable sources (groundwater, Hunter Creek, and lawn runoff) would result in a considerable decrease in algal bloom frequency and severity, and a 75% reduction would nearly eliminate algal bloom occurrence on Silver Lake

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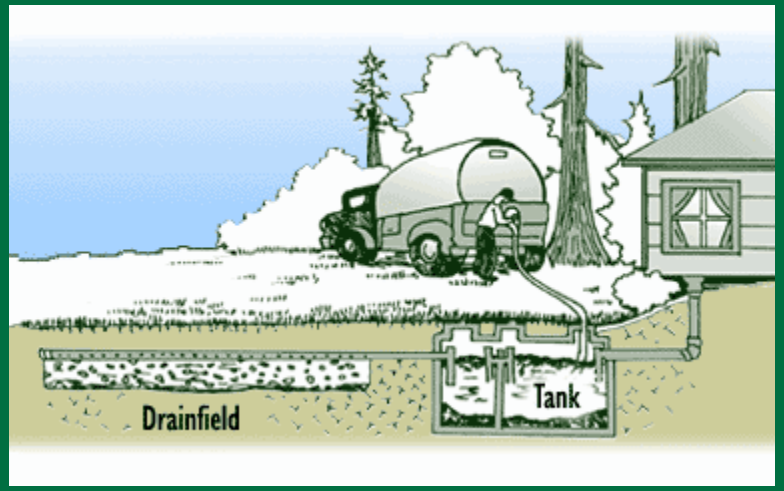
Preliminary Results – Nutrient Load Modeling cont.

3) Septic input to Silver Lake

- Septic model was calculated based on published literature values, occupancy, and soils
- A BATHTUB scenario was run using the septic model data produced using the likely (medium), high, and low septic loading estimates to determine the effect of conversion from onsite septic waste treatment to central sewer system



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Preliminary Results – Nutrient Load Modeling cont.

3 cont.) Septic input to Silver Lake

- The BATHTUB model predicted reduced P load to the lake between 10 to 48%, and reduced N by 0.2 to 3%
- The septic-removal simulation indicates that a complete removal of septic systems using the “likely” (medium) septic-load scenario would improve the lake to an average mesotrophic condition
- Based on the septic model results, the BATHTUB model indicates that the conversion of onsite septic treatment to sewers would result in an overall improvement in lake trophic status and greatly reduce the frequency of algal blooms and algal bloom intensity on Silver Lake

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Disclaimer

- This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government may be held liable for any damages resulting from the authorized or unauthorized use of the information

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